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ABSTRACT

This paper provides a critical review of economic models of employers' decisions to train workers: what training is undertaken, where it is undertaken, and who finances it. The focus of the review is on the provision of job training to workers with no unusual training problems. The first two sections consider the nature of on-the-job training more precisely, emphasizing the role of the firm in the supply of on-the-job training opportunities. Two alternative models of on-the-job training are considered and a few implications for the efficient supply of training services are derived. In section 3, a basic investment model of on-the-job training is developed, forming the analytical structure that will be used to frame the discussions to follow. The economic logic of this human capital paradigm is discussed at length because of its central role in forming the economist's conception of this market. In section 4, conditions under which the free market generates an efficient amount of on-the-job training are outlined. The discussion then proceeds to the important issue of why this market may fail to yield efficient results, most prominently the financing problem. The relationship of human capital finance to the deeper issue of property rights structures is explored. Analyses of variations on this fundamental problem comprise much of the remainder of this review, including the policy discussion of the final section. The potential for an alternative supply mechanism, employer training cooperatives, is critically examined. The final section considers ways in which the government can encourage the more efficient provision of on-the-job training. (37 references) (KC)

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6. THE FIRM'S DECISION TO TRAIN

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I. Introduction

Job training is a fundamental part of the total educational system in any industrialized economy, and the efficient provision of such training an important element in any comprehensive industrial strategy. In his classic study of on-the-job training, Jacob Mincer concluded a careful assessment of the aggregate importance of on-the-job training with the remark, "it is probably correct to say that, in the male half of the world, on-the-job training -- measured in dollar costs -- is as important as formal schooling" (1962, p.63). This research report provides a critical review of economic models of the firm's decision to train workers: what training is undertaken, where it is undertaken, and who finances it. In the final section, I consider ways in which the government can encourage the more efficient provision of on-the-job training.

Many critical job skills, e.g. reading and mathematical skills, are not typically learned "on the job", but are developed in a formal schooling environment. Presumably these attributes are almost universally demanded, so that economies of scale argue for collective provision. Many of these skills also have returns beyond any direct labor market returns, for example an informed electorate, and are collectively provided (subsidized) for that reason as well. The efficiency of the schooling system in providing these skills is often questioned, but only modest variations or reform have been proposed, suggesting that the basic structure (publicly financed, specialized training centers) is perceived as reasonable.

Skills more directly linked to the job are more eclectically supplied, reflecting perhaps the diversity of the skills required. Some job skills are learned in formal job training programs, either on-site or in

specialized centers not unlike public schools, while others are the informal outcome of work activity (learning-by-doing). Imposing some sort of logical structure on these disparate activities has been an important contribution of economic analysis.

In the final analysis training is an investment decision. The training process absorbs the worker's time as well as the time of co-workers and supervisors, various materials, and the indirect costs of mistakes made by the inexperienced worker. If the training is to be economically rational, these costs must be offset by the higher future productivity of the trained worker. Because these returns (and costs) are distributed over time, the financial aspects of the transactions are important as well. The financing of intensive on-the-job training activities is a serious obstacle to the efficient provision of a highly trained work force.

The distinction between the **training activity** itself and the **financing** of the training activity is an important one. The form of the training activity is in the first instance technological. What is the nature of the on-the-job learning mechanism? In what environment is the learning of job skills most cheaply provided: in the firm or in some specialized training program, e.g. schools? The financing issue is fundamentally one of access to capital, and is intimately related to the structure of the property rights system. The financing decision depends in an important way on the legal environment in which firm and worker exchange goods and services as well as promises of future exchanges. As in many economic decisions, the action decision (training) and the financing decision (who pays for the training) are intimately related.

The focus of this review is on the provision of job training to workers with no unusual training problems. The provision of job training

programs to seriously disadvantaged individuals is itself a major policy issue, possibly justifying extensive direct government intervention, but the direct government supply of trained (disadvantaged) workers is not a significant portion of the total supply of job skills in the economy. Job training in the United States has been overwhelmingly private, forged in a variety of ways among workers, firms, and unions. It is this market that is examined below.

The review proceeds in the following way. I first consider the nature of on-the-job training more precisely, emphasizing the role of the firm in the supply of on-the-job training opportunities. Two alternative models of on-the-job training are considered and a few implications for the efficient supply of training services are derived. In Section III I develop the basic investment model of on-the-job training, the analytical structure that will be used to frame the discussions to follow. The economic logic of this human capital paradigm is discussed at length because of its central role in forming the economist's conception of this market. In Section IV conditions under which the free market will generate the efficient amount of on-the-job training are outlined. The discussion then proceeds to the important issue of why this market may fail to yield efficient results, most prominently the financing problem. The relationship of human capital finance to the deeper issue of property rights structures is explored: the right of contract has been socially abridged for a variety of reasons, both by design (bankruptcy laws) and by the inadvertant decisions of judges and juries. Analyses of variations on this fundamental problem comprise much of the remainder of this review, including the policy discussion of the final section. The potential for an alternative supply mechanism, employer training cooperatives, is critically examined.

II. The Firm As Supplier of Training Opportunities

The distinction between schooling and on-the-job training is not always a clear one. The issue is more than one of vocational versus academic skills. Vocational skills that are obvious candidates for on-the-job training, e.g. carpentry, are often taught in public schools or in specialized training centers. In that sense on-the-job training must be considered as part of a broader eductional structure, with the observed mix of formal schooling and on-the-job training an equilibrium outcome. Neither is the issue simply one of the geographic locus of training. During the English industrial revolution, firms often provided traditional schooling activities to young workers, much as Hollywood provides tutors to young actors today and for the same reason, the convenient integration of work schedules and legal requirements for schooling. This is not what is normally implied by on-the-job training, which includes the notion of a paid or "on-the-clock" activity. In this review on-the-job training refers to any activity undertaken on the job (during work hours) that increases the worker's subsequent productivity.

Given the diffuse nature of this definition, the physical training activity is difficult to conceptualize neatly. The standard investment model of on-the-job training, discussed at greater length in the next section, is simply an extension of a schooling model into a period of incomplete specialization in education, Mincer (1962, 1974); Ben-Porath (1967); Heckman (1976); Rosen (1976); and Haley (1976). Individuals who wish to undertake a human capital investment program that involves less than complete time specialization in schooling are presumed to choose on-the-job

training. Why such activities should be undertaken during "paid" hours is not obvious.

The implications of this view for the optimal geographic locus of training activities are few: the part-time "schooling" could be carried on in schools or in the firm. The usual balance between economies of scale (in training) and commuting costs would presumably affect the outcome. For example, one could imagine that, if a large number of individuals in the same work place wanted to undertake the same course of study at the same time, transportation economies would lead to the activity being undertaken at the work place. If the labor market is competitive, one could also imagine that the training activity would be provided efficiently, with various inputs, including the individual's own time and assorted other inputs, combined in a rational fashion. The incomplete specialization model is in many ways like the Hollywood tutoring model; the training may occur at the work place, but does not capture much of the interaction of work activity and learning that is commonly associated with the notion of on-the-job training.

An intuitively plausible alternative model of the learning process is the learning-by-doing or learning-as-a-byproduct model. Evidence from the NLSY reveals that on-the-job learning is intimately related to what the individual does on the job, that is on his or her occupation, Parsons (1985). Among male youth in 1982 who had jobs and were not enrolled in school, approximately two-thirds of all professionals, managers, and craftsmen reported that their jobs had high learning content. In contrast, only one-third of laborers and service workers and only 25 percent of farm laborers reported that their jobs had high learning content. This suggests

that much on-the-job learning is the by-product of work activities and not simply incomplete specialization in schooling.

The learning-by-doing model emphasizes the importance of the underlying work activity and also the notion of learning rather than training. In this vein, Rosen (1972) has stressed the unique supply characteristics of training in the work place. Specifically, Rosen proposes that individuals be viewed as choosing among jobs based on a compensation bundle that includes both current wages and on-the-job training, which itself is determined by the technological characteristics of the job and on the firm's efficiency at providing such training. The interaction of these individual and employer choices yields the equilibrium level of on-the-job learning in the economy as well as the rate of return to the activity.

In many circumstances the distinction between these two training activity models is not an important one. In other circumstances, however, the differences may be pronounced. A key difference in the models is the implied degree of flexibility in the provision of learning opportunities. If firms are simply schools within the plant, the opportunities for on-the-job training should respond flexibly to shifts in worker demand. Conversely if such learning is primarily a by-product of work activities, then the firm may have much less flexibility in varying learning activities.

For example, as a by-product of work activity, the aggregate supply of on-the-job learning opportunities will be positively linked to the business cycle through new hires, etc. On-the-job learning will increase more or less in proportion to the expansion and contraction of employment opportunities. Conversely formal schooling tends to be mildly countercyclical; when current business conditions are difficult, individuals are more likely to remain in school. If on-the-job training is, in fact, well characterized

by an incomplete-specialization-in-schooling model, then one might expect to see a similar expansion of the training component of work when product demand contracts: the learning content of jobs should increase.

The focus on the supply characteristics of the training activity raises other issues as well. Specialization in the training function may occur across firms and industrial sectors; on-the-job training need not be conducted in the firm at which the worker is trained, Cho (1983). If the process involves explicit, controllable training programs, specialization will only occur if the training function is characterized by increasing returns. If on-the-job training is largely learning-by-doing, however, the learning accumulated by a firm's employees at one point in time may bear no systematic relationship to the amount demanded subsequently. An individual may find that he cannot use his newly acquired skills profitably in the current firm. In this case, learning may induce mobility.

Evidence for such specialization is reported by several investigators. Schiller (1986), for example, provides evidence that learning among new entrants to the labor force occurs disproportionately in small firms. These firms on net lose experienced workers to larger firms. Weiss (1985) attempts to resolve theory and evidence that 1) union workers are better trained than nonunion workers, but that 2) union workers are less likely to receive training (Mincer (1983)), by arguing that experienced, nonunion workers disproportionately migrate to unionized firms. I argue below (although this is no more than a conjecture) that the training provided in small firms is disproportionately rudimentary job skills, especially work discipline and cooperation, and that intensive on-the-job training is primarily carried on in large firms, principally because of the ease of internal financing.

On the production side, on-the-job training can be viewed as simply another product of the firm. To the extent the final product market activities are efficiently organized, one could assume that the time of worker, supervisor, and co-workers and the related direct costs devoted to the training will in general be in efficient proportions and combined rationally into a final trained product. One unique problem that arises in the provision of training is obtaining the cooperation of co-workers, Reagan (1988). The heart of the cooperation problem is that workers are being asked to train their own potential replacements. This is not a serious problem if the market is large and the trainers are specialists, but may be serious in internal labor markets in which the trainers are co-workers. The problem is an ancient one. Noncompetitive provisions were an important part of early apprenticeship contracts; the apprentice's right to compete with the master was often limited, e.g. he could not establish a shop within a fixed range of the master's own shop. If the employees doing the training are closely monitored, this type of malfeasance may be limited. If the training personnel have a great deal of discretion, however, as would be the case in less formal training programs, the problem may be an important one.

Reagan (1988) has argued that seniority rules on lay offs and promotions are in part an institutional way of reducing this obvious conflict of interest. I assume below that these institutional rules are in fact sufficient to enable the firm to produce the training activity efficiently, given the amount of training that is to be undertaken. In the next several sections I develop more carefully the issue of the efficient amount of on-the-job training. The training specialization issue is considered again in Section VII, when the implications for training of the recent restructuring of the industrial base in the United States are derived.

III. On-the-Job Training: An Investment Perspective

Economists view the on-the-job training decision as one of a broad class of human capital investment decisions, Jacob Mincer (1962, 1974). The heart of the decision calculus is as simple as it is powerful. The training activity typically involves a period in which the worker is not as productive as he might otherwise be. The training activity may involve other costs as well, including the diversion of supervisor and co-worker time and energies to the training process, purchased training materials, and unusually high scrappage rates (or lost business opportunities at the management trainee level) due to a high incidence of mistakes. Set against these costs is the increase in worker productivity after the training period.

It will be useful to formalize the investment decision. Denote the worker's productivity flow in the absence of training as v_t, which when discounted at the interest rate r, promises lifetime wealth (W) of:

$$W \text{ (No Training)} = \int_0^\infty v_t \, e^{-rt} \, dt. \qquad (1)$$

If productivity is fixed forever at a level v, that is $v_t = v$, for all t, the wealth formula takes on the simple form:

$$W \text{ (No Training)} = v/r. \qquad (2)$$

Productivity is likely to decline at some point and indeed fall to zero at death or retirement, but the constant productivity assumption underlying Equation (2) may still be a useful approximation, especially if retirement is many years in the future, or the interest rate is high.

The training alternative also involves a time flow of productivity, say v_t^*, and may include some direct costs of training at each instant, say d_t. The lifetime wealth implied by the training alternative is:

$$W \text{ (Training)} = \int_0^\infty (v_t^* - d_t)\, e^{-rt}\, dt. \qquad (3)$$

If for example the training period is of duration T, during which the worker's productivity is v_0^* and direct training costs are d, and after which the worker's productivity is v_1^*, the worker's lifetime wealth in the training regime is:

$$W \text{ (Training)} = (1/r)\, [(v_0^* - d)\, (1 - e^{-rT}) + v_1^*\, e^{-rT}], \qquad (4)$$

where T denotes the end of the training period.

The <u>efficiency criterion</u> is a simple one: the training activity should be undertaken if and only if the worker's productive wealth in the training regime equals or exceeds his or her productive wealth if untrained, where all wealth computations are undertaken at the social discount rate, say ρ. Formally this means that training is economically efficient if and only if:

$$W \text{ (Training} \mid r=\rho) \geq W \text{ (No Training} \mid r=\rho), \qquad (5)$$

or in the special case represented by Equations (2) and (4):

$$(1/\rho)\, [(v_0^* - d - v)\, (1 - e^{-\rho T}) + (v_1^* - v)\, e^{-\rho T}] \geq 0. \qquad (6)$$

In the typical case in which $v_0^* < v$, and $d > 0$, the post-training productivity v_1^* must exceed the untrained productivity by an amount sufficient to cover the foregone earnings $(v - v_0^*)$ and the direct training costs during the training period T:

$$v_1^* \geq v + (v - v_0^* + d)\, (e^{\rho T} - 1). \qquad (7)$$

<u>An Example</u>. A simple example illustrates the sensitivity of the efficient training decision to the interest rate when the training period is

lengthy. Consider a worker whose productivity before training is $15,000 per year, who is able to acquire an additional skill in three years, but only if his current productivity is reduced say by one-third during the training period, to $10,000 per year (assume also that direct costs, materials, etc. are negligible, d=0):

$$v = \$15,000 \text{ per year;}$$

$$v_0^* = \$10,000 \text{ per year; and}$$

$$T = 3.$$

At a social discount rate of 10 percent, the additional training would be socially efficient only if the worker's post-training productivity (v_1^*) was $16,749 per year. At a social discount rate of 20 percent, the training would be socially efficient only if the worker's post-training productivity was $19,111 per year. The set of efficient training oportunities is likely to be seriously reduced in the high interest rate regime.

IV. Training Efficiency and the Free Market

The question naturally arises, what institutional structure, if any, will generate the efficient job training outcome. Economic experience suggests that free markets will induce efficient behavior over a broad range of environments; economic theory demonstrates that they will do so in more narrowly restricted circumstances. In the current situation, a free labor market composed of wealth maximizing individuals should be efficient if:

i) the worker has access to capital at the social discount rate;

ii) a large number of firms demand the skills developed; and

iii) job changing is costless.

In such a world, the worker would receive at each instant a wage equal to his or her net productivity; assuming that the firm provides all training materials, the competitive wage at each instant t should be:

$$w_t = \begin{cases} v_t & \text{if no training;} \\ v_t^* - d_t & \text{if training.} \end{cases} \qquad (8)$$

This market outcome has strong efficiency implications. The wealth maximizing worker facing this wage structure would train when training is efficient, and would not train when training is inefficient. If the direct training costs are paid directly by the worker, the wage in the training alternative would not include an implicit charge for this material; the conclusion that the individual would choose efficiently among the alternatives is unchanged.

A model of this sort has provided the basis for a highly successful model of life cycle wages in the post-schooling period. The pioneering work in this area, especially Mincer (1962, 1974), is based on this theoretical linkage between training and wage growth in a competitive spot market for labor services: in such a market, learning on-the-job leaves predictable patterns in the wage/experience profiles of young workers. The optimal time path of life cycle learning and earnings was first formally derived within a simple structural environment by Ben-Porath, and was extended and empirically implemented by Haley (1976), Heckman (1976), Rosen (1976), and others (see Weiss (1986) for a review of this literature). Empirical implementation of these models requires strong assumptions on a variety of environmental and technological conditions. As a consequence the simple log

earnings function approximation to this process remains a standard estimating tool. For an excellent critical review of the standard model, see Hanushek and Quigley (1985).

Becker (1975) used a simple investment model to assess the efficiency of the provision of college educations in the United States, In particular he found that the after-tax rate of return on a college education was comparable to that on physical capital, a strong indication of efficiency in the college market. Unfortunately the same analysis cannot be used to assess similarly the aggregate efficiency of the market for on-the-job training. To understand why, it is necessary to sketch out briefly the standard wage model. In the standard log wage function, "t" years following school departure, the log wage can be represented by the approximation (ignoring individual subscripts):

$$\text{Log}(w_t) = \text{Log}(w_0) + rH_t - \Delta H_t + \varepsilon_t, \qquad (9)$$

where w is the observed wage rate, H is the stock of accumulated on-the-job learning capital, ΔH is the current period addition to that stock (current learning activity), and ε is a random element. The initial post-schooling wage $\text{Log}(w_0)$ is assumed to be a linear function of a variety of attributes:

$$\text{Log}(w_0) = X\beta, \qquad (10)$$

where X is a vector of personal productivity attributes, such as schooling, intelligence, etc. With all variables directly observable, the coefficents as well as their standard errors can be estimated efficiently using ordinary least squares techniques under common assumptions on the error term ε (iid

normal). Of special interest here the coefficient (r) on the stock of human capital variable (H) can be interpreted as a rate of return on on-the-job training.

Unfortunately the stock of on-the-job training is not directly observable. Instead the model is normally implemented by assuming a simple investment pattern. In particular, assume that:

$$H_t = \sum_{i=0}^{t-1} \Delta H_i = \sum_{i=0}^{t-1} \lambda_i k_i \qquad (11)$$

where λ_i is a dummy equal to one if the individual has a job in period i, zero otherwise, and k_i is the share of total human capital in period i devoted to learning activities. The standard treatment for male earnings is to impose the assumption that $\lambda_i=1$ for all i and that on-the-job investment shares decrease at a linear rate with job market experience:

$$k_i = \kappa_0 + \kappa_1 E_i, \qquad 0 < \kappa_0 < 1; \quad \kappa_1 \leq 0 \qquad (12)$$

where $E_i = i$ in this model. This investment structure induces a log wage model with experience and experience squared terms, at least over the range of value for which k_i is feasible (positive):

$$H_i = \kappa_0 E_i + (\kappa_1/2)(E_i)^2. \qquad (13)$$

In many applications, a second level of empirical approximation is required since work experience itself is not available in the data set. In particular, a common assumption is that work experience is age minus schooling minus six. In almost all empirical applications of this model in which the

sample age intervals are sufficiently broad to permit precise estimation, log wage is estimated to be a positive, concave function of experience. Unfortunately the rate of return on on-the-job is not identified in this structure; it can only be jointly estimated with the share of training time parameters K_i .

More direct measures of on-the-job learning permit a more persausive test of the on-the-job training hypothesis, but also fail to identify the critical rate of return to training parameter. In Parsons (1985), for example, an on-the-job learning variable is constructed from a question designed to elicit the respondent's self-perception of learning activities. The instrument had four categories of response, indexed by L_j, $j=1,2,3,4$, with 4 denoting the highest learning condition. This instrument provides an alternative, direct measure of human capital investment and stock under competitive assumptions,

$$\Delta H_i = \sum_{j=1}^{4} \alpha_j L_{ji}, \tag{14}$$

and

$$H_i = \sum_{i=0}^{t-1} \sum_{j=1}^{4} \alpha_j L_{ji}. \tag{15}$$

Presumably $0 < \alpha_1 < \alpha_2 < \alpha_3 < \alpha_4$ if the self-assessment measures are valid. Since the "no job" status is the base category, the empirical equivalence of the learning content of "no job" and of a "no learning" job can be tested as the hypothesis that $\alpha_1 = 0$. Estimates of such a model are consistent with the basic on-the-job hypothesis, Parsons (1985), but the rate of return measure is again not identified, being jointly estimated with α_i. The fact that the on-the-job-training hypothesis is broadly consistent with the observed pattern of post-schooling wages does not imply that this training

is efficiently provided, but rather that the market for on-the-job training is not fundamentally perverse.

Institutional features of the United States labor market raise the possibility that the market mechanism set out in Equation (8) may not be feasible. The competitive labor market model suggests that "equalizing or compensating differentials" should exist, so that individuals in high learning jobs (with the prospect of higher future wages) will receive lover current wages, much as individuals in formal schooling must forego current income. A variety of plausible institutional forces, however, may support wage rates above competitive levels, most obviously a legal wage minimum. A number of studies report evidence that on-the-job training is restricted by effective minimum wages, Fleisher (1981), Leighton and Mincer (1981), and Hashimoto (1982). Social forces may also limit the ability of workers to pay for job training through wage deductions during the training period. Lazear (1979), for example, has recently argued that affirmative action pressures have had perverse effects on the provision of on-the-job training activities to black youth. In particular he argues that average current wages are the most visible indicator of discrimination, so that employers have an incentive to shift black workers systematically into low-learning/high-current-wage jobs (under the standard equalizing differential argument). The logic of the argument depends on the specific observability assumption: that affirmative action enforcers observe wages and not learning activities. This empirical assumption is not plausible for formal training programs. It seems unlikely that an employer under affirmative action pressures would restrict entry by blacks into training programs. The insight may be valid, however, for more informal learning-by-doing activities for which no statistics or measurements are available.

Work by Barron, Black, and Loewenstein (1985), based on employer reports of training activity, and by Parsons (1985), based on self-reporting of on-the-job learning activity by workers, both suggest that compensating differentials are not significant. The Barron, Black, and Loewenstein data contained only modest individual quality controls, and they attribute the absence of an observed compensating differential to unmeasured quality characteristics of trainees. The phenomenon is also observed in the Parsons study, however, which includes much richer individual controls, including the extensive aptitude and achievement information in the Armed Services Vocational Aptitude Battery.

In any case it is theoretically possible for the firm to work around the minimum wage constraint by having the worker enter explicitly into a financial transaction (an explicit loan) that breaks the link between current wages and current training. Full payment of wages and a corresponding bill for the training, appropriately financed, should provided an equivalent solution to the investment problem. In the next section we shall see why this is not done.

V. The Financing Problem

Prominent among the sufficient conditions for the free market in on-the-job training to be efficient is the requirement that workers have access to capital at the social rate of discount. One would suspect that this condition does not hold empirically, even approximately. Workers undertaking substantial job training investments are often young, with only insignificant capital holdings. Even among older workers, a substantial

fraction of those considering substantial human capital investments are displaced workers, many of whom have similar financial difficulties.

If the training investment is a significant one, the financing problem may substantially increase the costs of undertaking the activity. Consider again the example developed above (Section III): a worker whose productivity before training is $15,000 per year is able to acquire an additional skill in three years, but only if his current productivity is reduced by one-third during the training period, to $10,000 per year. A worker who must borrow at a rate of 20 percent to make up the three year shortfall in income of $5000 per year will require post-training income of $19,111 per year to undertake the investment. If the firm's effective interest rate is 10 percent, the capital cost of the trained worker is 11.7 percent higher if the worker is required to finance the investment than if the firm can directly finance the investment, implicitly lending the worker $5000 per year for the three year investment period (by paying him or her the full wage of $15,000 per year), and then capturing the return by continuing to pay the worker $15,000 in the post-training period.

The incentive for the employer to supply the worker with the needed funds in some form is evident. In this section I first explore the nature of the borrowing problem that limits the worker's access to funds in general and then explain why the firm has a unique role as provider of the resources required to finance the training.

A. The Worker's Ability to Borrow: The Property Rights Issue

Obviously limitations on worker credit is a serious problem if the worker is expected to finance a major investment activity. The amount of training activity will be less than the efficient level and the more limited supply of trained workers will translate into higher costs to the firm of trained workers. To consider solutions to the problem, it is necessary to understand more completely the nature of the borrowing difficulty; a property rights perspective will be useful.

Consider a world of certainty with completely enforceable contracts, so that an individual who commits to a specified payment scheme is not able to avoid these payments. The financing of the training program in this environment is unlikely to be a problem; the least cost provider would supply the funds, whether that provider is the worker, the firm, or a financial intermediary, and ceteris paribus the training would be supported at least cost.

Two important processes arise that make financial contracts of this type incompletely enforced -- default and bankruptcy. An individual who dies with debts exceeding assets does, in a sense, take it with him, his creditors are out of luck. Less drastic means of avoiding repayment also exist. If the debt is sufficently small or the costs of collection sufficiently high, then the creditor may write off a specific debt. Bankruptcy introduces social values into the debt collection mechanism. If the individuals debts exceed his or her assets, he or she may from time to time declare bankruptcy, distribute the assets proportionately among the creditors, and return to a zero net asset position. A special problem with human capital investments is that the resulting capital is not viewed as an

asset in this computation; such investments do not create their own collateral, they are an invitation to bankruptcy.

To illustrate the importance of the financing aspect, consider an historical example that illustrates the basic principles of the problem in an extreme way, the practice of indentured servants. In the Colonial period land and natural resources were abundant in the United States, but labor shortages were severe. A basic problem was the high cost of transportation from areas of relative labor surplus, the Old World, to areas of labor shortage, the New. The cost of passage in the early seventeenth century was almost one and one half times the income per person in a laboring family, Galenson (1981, p.230). Equally important was the financing. The individuals most likely to find migration to the New World economically attractive were those in the most unfavorable economic conditions, a group unlikely to have significant capital holdings to finance the cost of passage.

An institutional response to this problem was the development of the practice of indentured servants. Individuals could purchase passage to the Colonies by promising to work for a master for a fixed period of time, typically for four years or more, depending on skill and other personal characteristics. Indentured servants were a major source of labor in the colonial period; Galenson cites two accounts that claim that one half to three quarters of the immigrants to the Colonies in the seventeenth century were indentured servants (pp.3-4). Over time slave labor came to dominate this market, but for an extended period of time this alternative, the long term commitment of labor services, was the dominant institution for handling the problem of financing migration.

More than a simple labor contract was involved. "...indentured servitude did involve a stricter obligation than most forms of labor contract because the system provided for the enforcement of the agreement by requirement of specific performance of the work described in the contract", Galenson (1981, p.3). Commercial law developed around indentured servants contracts: they could be, and were, freely bought and sold for the duration of their indenture periods. The control problem with indentured servants was a serious one. Such contracts could not permit bankruptcy: few of these individuals had significant physical assets upon arrival to set against their transportation debt. The problem was deeper: the new arrivals had to be secured to their place of employment and motivated to work for another without the usual free market incentives. In this resource-abundant society, runaways were a special problem. To assist in the enforcement of this type of contract, colonists were required to carry internal passports.

A modern and somewhat less exotic example is the government's funding of training of military officers, most prominently in military academies. These institutions provide an expensive college education at no cost to those selected to participate. Indeed the various armed services pay attendees a substantial wage during the training period. At the end of the training period, attendees are very much in debt to the government. Payment again is by specific performance, the individual is required to serve a minimum length of time with the "firm", in this case one of the military services. The individual can also be funded to attend professional school, with an additional number of years added to his or her service requirement. The commitment is not subject to personal bankruptcy.

Both examples, the historical and the modern, illustrate i) the basic problem of financing an expensive training activity, ii) the institutional responses to the problem -- contracts with specific performance requirements, and iii) the difficulties that the responses themselves generate -- any long term contract involves some limitation on the individual's freedom. Private employers today do not have the specific performance option. Nonetheless they have a unique role in providing personal financing to workers with modest capital. The nature of the lending mechanism and its limitations are developed in the next subsection.

B. The Unique Role of the Firm

The problem of funding human capital investments with third party loans is a serious one. Of particular importance here, the employer has an alternative debt repayment mechanism, one that provides for repayment despite the bankruptcy constraint, namely job mobility costs. If mobility costs are high, the employer can invest in the worker, knowing that the worker cannot strategically respond by leaving the firm. The bankruptcy problem is preempted; the individual cannot go to court and have the debt erased. Mobility costs are an essential element in a variety of long term implicit contracts, for example, if the firm supplies productivity insurance, either across the business cycle or across the life cycle. The firm cannot pay above average wages when conditions are adverse, without paying below average wages when times are good, an arrangement that is only possible if mobility costs are significant.

The limitations on this mechanism are clear. No individual is completely immobile; if the firm becomes a sufficiently large (implicit)

creditor to the worker, the worker has an incentive to leave the firm and seek work elsewhere. Consider once again the example developed above: a worker whose productivity before training is $15,000 per year who is able to acquire additional skills in three years, but only if his current productivity is reduced by one-third during the training period, to $10,000 per year. If employers, with access to capital at 10 percent, finance the entire investment for all workers, they will presumably pay the worker $15,000 per year during the training period and after. The equilibrium productivity of workers with these skills would be $16,749 (assuming firms would continue to train workers as long as the returns to them, the employers, remain positive when the investment is evaluated at 10 percent). Barring any collusive agreements among employers, firms would be willing to pay up to $16,749 for trained workers, if they could find them. Obviously mobility costs must be substantial for workers to accept $15,000 per year in the current firm when $16,749 per year is available from other firms. Less significant mobility costs would permit firms to finance only a portion of the training costs.

One interesting model combines on-the-job investment and the mobility process within a life cycle framework, Jovanovic (1979b). Jovanovic argues that the time profile of on-the-job learning will interact with expected mobility in a systematic way in an optimal investment program. Given the high turnover rates among new hires, perhaps due to job shopping over nonpecuniary aspects of the job, employers may not offer valuable training opportunities to new entrants until they have shown that they are stable and unlikely to leave the firm for an alternative employer. See also Lester (1954) and Bishop (1985). As a consequence, the life cycle profile of job learning intensity may <u>increase</u> early in the individual's career, not

decline as assumed in the standard on-the-job training model, Equation (12). The Jovanovic hypothesis assumes that on-the-job learning activities include important worker/firm match specific elements: the returns to on-the-job learning are partly (or wholly) dependent on the worker having a continuing relationship with the firm in which the investment takes place. By definition, interfirm mobility will completely depreciate the specific human capital. Similar results hold for general capital with positive mobility costs.

VI. Worker Immobility and the Employer Holdup Problem

The employer has mechanisms for providing the worker with a loan that is not vulnerable to bankruptcy or to default in the usual sense. To the extent the worker's job mobility is limited by effective long term employment contracts or by high transaction costs, the firm can finance the worker's training costs by paying the worker more than his productivity during the training period and then recovering the expenditures by paying the worker less than his productivity in the post-training period. Both explicit long term contracts and intrinsically high worker mobility costs introduce their own difficulties, however. A few of these are considered here as are the market forces that ameliorate their effects.

Long Term Employment Contracts. If it were possible to bind the worker to the firm, it would not be difficult in a static world to design a long term employment contract that permits the employer to absorb some or all the training costs, if that is efficient. If the labor market in which the basic employment contract is negotiated is competitive, post-training wages will be set at a level that just compensates the firm for its training

outlays. The least cost provider of capital in this relationship will absorb the majority, perhaps all, of the training costs, as efficiency dictates.

Unfortunately the world is dynamic, not static; conditions are constantly changing and in unpredictable ways. Complete worker immobility is almost surely inefficient in such a dynamic environment; an unexpected increase in the worker's productivity outside the firm or a sudden decline in the worker's productivity inside the firm calls for the reallocation of the worker to a more productive work setting. Explicit mobility bonding schemes can in principle handle this problem, Mortensen (1978) and Hashimoto (1981). See also the review in Parsons (1986). The party that wants to break the contract can be required to pay a penalty to the other party for the breech; properly designed in an ideal environment, such a bonding mechanism can induce efficient behavior.

The use of explicit bonding schemes in this case is limited by information problems, most obviously the identification of the party that precipitated the job change. This critical information may not be observable to an outside (enforcement) party. The worker may voluntarily leave the firm (quit), but only under (unobservable) pressure from the firm; conversely the firm could lay off or fire the worker, but only after the worker became slack or malfeasant on the job. Hashimoto and Yu (1980) consider more efficient contracts with imperfect observability. The mobility bond is indexed to observable proxies correlated with separation culpability; the efficiency of the bond then is a function of the quality of the proxies.

Casual empiricism suggests that such elaborate mobility bonding schemes are not often observed in practice, and that the difficulties in

implementing explicit long term contracts are serious ones. Whether this is the result of intrinsic problems in the approach or to legal problems of enforcement of long term employment contracts is unclear. The legal enforcement of long term contracts is at best fitful, Green (1989). Enforcement depends in the main on interpretations by the various state court systems, which vary in their commitment to contractual agreements of this sort over time and across states. In general courts seem reluctant to restrict the worker's freedom to seek alternative jobs.

High Mobility Costs. High interfirm mobility costs provide an alternative to enforceable long term contracts. If it is expensive for the worker to relocate, then the firm can hope to pay the worker a wage less than productivity in the post-training period without losing him or her to another firm. A concern naturally arises, however: what keeps the firm from extracting more than its share of training costs? Once the worker is in place, the potential for exploitation of immobile workers would seem a real one. What keeps the employer from squeezing all quasi-rents out of the worker? Of course there exists a symmetry here if the firm invests in the worker, the worker may attempt to extract a disproportionate share of the returns by threatening to leave the firm; such a threat becomes less credible the higher mobility costs, but it is never totally absent.

If the labor market in which the original job commitment is made is a competitive one, the firm could not expect to extract more than its share of training costs out of the worker, at least if the worker correctly aniticipates the firm's post-training wage behavior. If the worker anticipates that the employer is going to act exploitively in the post-training period, then the worker will require a higher current wage from the firm. In a sense the unreliable firm will be forced to accept a larger

share of the investemnt. Conversely if the firm anticipates that the worker is going to capture a disproportionate share of the rents, it will insist that the worker bear a greater share of the investment costs.

The efficiency problem is that the investment cost sharing decision may be made, not on the basis of differential access to capital, but on the basis of expectations of future quasi-rent sharing. This problem has been considered at length in the employment contracting literature. Specifically a literature has developed considering the most extreme possibility of an employer-employee lock-in, "firm specific human capital", in which a skill only has value in one firm, presumably the firm in which the training occurs, Becker (1975) and Oi (1962). More widely valued human capital with positive mobility costs can be considered a generalization of the specific human capital model (mobility costs induce economic specificity).

Two approaches to implicit contracting and specific human capital investment sharing have been proposed, both of which stress the anticipation of subsequent quasi-rent sharing in the determination of investment cost shares. The early literature -- Becker, Oi, and also Parsons (1972) -- focused explicitly on the interplay between the specific human capital financing decision and job mobility. The worker is never completely immobile; individual heterogeneity insures that worker mobility is only a probability statement: some workers will stay, others leave, with only the proportion of stayers and movers in the work place changing as compensation changes.

This literature explores a weak form of employment contract; wages are fixed (with mobility processes in mind) and firms and workers respond through layoffs and quits respectively. In these models, the worker quits whenever outside productivity exceeds the (fixed) wage, and the firm lays

off the worker whenever the wage exceeds inside productivity. Job separation is not fully efficient under this simple contract if outside and inside productivity are subject to random shocks, due to product market demand fluctuations, technological shifts, Hashimoto (1981) and Parsons (1986). The incentives of the two parties do not adjust optimally in this stochastic environment. Becker (1975) first proposed that there may be some optimal investment sharing between firm and worker that will minimize this inefficient separation. The financing of and returns to the investment will be shared between firm and worker because some investment by each reduces the incentives for unilateral withdraval from the relationship by the other: investment sharing is a form of mobility bond. The investment sharing is not fully optimal, depending as it does on the bonding device, namely the shapes of the quit and lay off functions as well as on more fundamental factors.

A second approach to investment cost sharing also places much emphasis on the forces that determine post-training rent sharing, Grout (1984). As in the turnover model, Grout argues that the worker and firm are forward looking, that they can anticipate the outcome of subsequent bilateral bargaining, and that they accept financial shares based on this perspective. He employs a bargaining model rather than a relative turnover model as the structure that underlies rent sharing in the post-training period. Specifically he assumes that a Nash bargaining model can be used to formalize the "solution" of the bargaining process. Bargaining models of this sort assume that the bargaining outcome has features consistent with some set of stylized facts. The Nash model, for example, assumes that the bargaining outcome meets an intuitively plausible fairness criterion. The

efficiency problem is the same as in the turnover model -- the sharing is driven by a process other than access to capital.

Reputational Enforcement of Implicit Contracts. The market itself may generate (partial) solutions to the hold-up problem, especially through reputational forces. Employers, especially large employers, may find it profitable to behave as if they are legally bound to a contract, even when they are not. In the current case, the firm may behave as if it has a commitment not to exploit the worker once the worker is locked-in to the firm.

Despite the potential importance of these reputational forces, empirical evidence on the situations in which they are operative remains limited. The evidence indicates that reputational enforcement of implicit employment contracts is largely a large firm phenomenon. It may be useful to consider briefly an important example of this literature. Consider the inflation-adjustment of retiree benefits after retirement. Such adjustments are rarely contractual commitments, but instead depend on reputational forces for performance. In that respect such adjustments provide strong evidence for (or against) the existence of reputationally enforced employment agreements. Clark, Allen, and Sumner (1986) report on the post-retirement adjustment of pensions during the high (and unexpected) inflation period of the 1970's. In the pension sample analyzed by Clark, Allen, and Sumner, the change in benefits as a percent of the change in CPI over the 1973-1979 period among pre-1972 retirees was 37.9 percent (p.185). The adjustment was 45.2 percent among union plans, only 29.2 percent among nonunion ones. Much of this difference, however, appears to be due to the disproportionate union representation in large firms. Consider the reported

variation in post-retirement adjustments in benefits by collective bargaining status and plan size:

The Change in Mean Pension Benefits between 1973 and 1979
As a Percentage of the Change in CPI among Pre-1973 Retirees,
By Plan Size (1979) and Collective Bargaining Status

	1-99	100-499	500-999	1000-4999	5000-9999	10,000+
Collective Bargaining	6.3%	18.8%	17.9%	13.3%	33.3%	66.7%
No Collective Bargaining	5.2%	26.7%	25.0%	15.8%	32.5%	42.8%

Source: Clark, Allen, and Sumner (1986).

Parsons (1988) has confirmed the Clark, Allen, and Sumner findings in a multivariate analysis based on the older male cohort of the National Longitudinal Surveys. Large firms appear to be much more driven by reputational processes than are smaller firms, which in turn suggests that workers may be more likely to enter into long run relationships, for training or other purposes, with large firms.

VII. Secular Trends in Work Place Structure: Consequences for the Supply of Training

Recent industrial trends have strongly favored smaller, nonunion work places. The decline in the large firm sector is largely attributable to the well-noted (relative) decline in manufacturing employment, and the growth of the service sector. The economies of scale that induced the rapid growth of large industrial enterprises in earlier periods are apparently more limited in the service economy that has blossomed in the past several decades. This industrial restructuring is apparently a long term one;

between 1970 and 1986, employment in the manufacturing sector declined as a share of total employment from 26.4% to 19.1%, U.S. Bureau of the Census (1987, p. 379). Over the same time interval, employment in the service sector expanded from 25.9% to 31.3%. Even within industrial sectors, trends appear unfavorable to the growth of large enterprises. Although consistent time series data on recent trends in firm size within industries is unavailable, casual evidence suggests that firm size has declined within sectors as well as in aggregate.

Reflecting in part this structural shift, the unionized sector of the labor market has shrunk dramatically. The decline in union representation in the work force has been precipitous, with union membership dropping from 25.6% of nonagricultural employment in 1973 to 14.1% in 1985, Farber (1985). This decline again is only partly explained by sectoral shifts, Farber (1985).

What is less clear is the implications of this industrial restructuring for the provision of on-the-job training. As noted above, Section II, several economists have argued that training is disproportionately carried on in the nonunionized, small firm sector. Schiller (1986) reports that learning among new entrants to the labor force occurs disproportionately in small firms. These firms on net lose experienced workers to larger firms. Mincer (1983) finds that union workers are less likely to receive training than are nonunion workers.

Does this mean that the aggregate supply of trained workers is improved by these recent sectoral shifts? I think not. I suspect that the preponderance of training activities in small, nonunionized firms is limited to the provision of relatively rudimentary job skills. Employment in a fast food outlet, a common entry level job, no doubt teaches the young person a

number of useful job skills, including the value of punctuality and cooperation. What is more difficult to undertake efficiently in the small firm setting is the training of highly skilled craftsmen and operatives. The individual worker's problem in financing a training program is likely to increase with the size of the investment. A highly skilled machinist, under current limitations on contracting, may have serious financial difficulty financing his investment. At the same time, the low mobility costs implied by a large number of similar firms make the investment an unattractive one for the small employer to finance; the likelihood that the employer will be able to capture a significant share of the training returns is small. If true, the training of highly skilled workers may become a matter of increasing concern in coming years.

VIII. Public Policy Issues: Support for Private Job Training

The policy issue is an important one: how best to foster the efficient provision of job training. I have argued above that the main problem is one of financing. The firm typically has access to credit at rates substantially below those available to most trainees. The firm cannot simply lend the worker the resources, however, because of the possibility of bankruptcy and default. If the worker is relatively immobile (has high job changing costs), it may be possible for the firm to lend resources implicitly to the worker through its wage policy, in a sense absorbing the investment costs (and returns) itself. This avenue of finance is partly dependent on high job mobility costs, however, and especially in this period of sectoral shifts toward smaller firms (and perhaps lower intrinsic

mobility costs), consideration of alternative financing mechanisms is essential.

Direct provision of training programs by the government is not likely to be productive (beyond the provision of basic skills to seriously disadvantaged individuals). The main argument against direct government involvement is informational; the market is a complex one, with thousands of firms demanding thousands of skills and in turn supplying a corresponding number of job training opportunities. Knowing which services to offer and which to eliminate is an immense coordinating task. Clearly this is a market in which decentralized decision-making is essential.

The issue is hov to encourage and support job training at arms length, that is with limited direct governmental micro-management. An obvious solution is the public provision of job training loans to workers, comparable to educational loan programs. To state the solution is to state the problem: the government student loan program has faced the same sort of problems that have beset the private capital market. Particularly among the young, access to a large amount of capital is an invitation to default and bankruptcy. More importantly it is an invitation to fraud, of which this group, especially the least educated, are themselves likely to be victims. To the extent that job training is less well defined than is formal schooling, the invitation to deception and fraud by suppliers of training is increased. Without a fundamental change in the rules of the game, the problem is likely to remain severe.

A fev positive steps to assist the efficient functioning of this market have recently been made, the most obvious being the "repeal by inflation" of the minimum wage. The beneficiaries of this policy shift are likely to be the least skilled, those whose training wage would drop them to

minimum wage levels, historically around one half the average wage in manufacturing. The policy is likely to have had little impact on highly skilled workers, such as machinists, whose training wages are likely to be well above the minimum wage (although this fact may be changing with the increased competition in this sector). In that sense eliminating the minimum wage is only a partial step toward a more complete solution of the training problem, although perhaps an important one, given the social interest in the well-being of the least skilled.

Tax policy is another potential mechanism for the governmental encouragment of job training in the private sector. Current tax laws permit (require) training costs to be "expensed" rather than amortized over the life of the investment as with physical capital investments. If i) the tax structure is not progressive and ii) the interest rate is positive, this tax system favors human capital investments, whether undertaken by the firm or by the worker. The rate-of-return measurement problem (discussed in Section IV) above makes difficult a quantitative assessment of the impact of the tax structure on training activity. The use of tax policy to foster indirectly various governmental non-revenue objectives is currently out of fashion, but that condition may not last.

Given that the financing problem is at its core a property rights issue, reformation of the contract system would seem to offer hope for significant improvement. The issue is a delicate one, however, since the limitations on the ability to contract, i) the right to declare bankruptcy when debts exceed assets, and ii) the right to (relatively) unrestricted job mobility, are based on important social values. It is possible, however, that modest adjustments could be made in each that would facilitate the supply of credit to trainees. It may be enough to strengthen the worker's

right to contract with the firm over a specific employment period, or at least a period in which the individual would not work for a competitor, thereby encouraging worker-firm training relationships that are now partly, and imperfectly, cemented by positive mobility costs. Elimination of bankruptcy possibilities for a certain class of loans is another alternative, although the potential for creditor abuse of financial structure is a real one. In a sense what is required is a refashioning of apprenticeship contracts.

The encouragement of employer training collectives for the development of skills specific to an industry or type of technology may also be useful. If a highly specialized skill is demanded by a relatively small number of employers, a training cooperative may be designed so that the employers with their access to lower cost capital may have an incentive to finance the investment activity themselves. As argued at length above employers will agree to finance investments in worker skills only if they are able to capture the returns on the investment through subsequent wage payments that are less than the worker's productivity (by an amount sufficient to compensate them for the training costs they incur). An agreement to share the costs of training in proportion to the employer's share of new trainee hires would achieve the desired object <u>if</u> combined with a "no raiding" agreement on previously hired workers. In the absence of such an agreement a charging mechanism based on the new hires of trainees would break down, with rational employers bidding up the wages of experienced workers to the value of marginal product, thereby eliminating the necessary payback period. A "no raiding" agreement is unattractive for a variety of reasons: there are, for example, many reasons for workers to want to change

jobs that do not involve wages, e.g. changes in geographic preferences and personality conflicts with supervisors and coworkers.

An alternative charging mechanism that would permit workers to change jobs freely and at the same time protect the employer's investment in the worker would be an agreement by the employer to share training costs according to the total number of cooperatively trained workers currently on the employer's payroll. If aggregate training levels are stable over time this charging scheme is efficient: employers could hire trained workers from other firms, but they would be responsible for the workers' training costs as well as for the workers' current wages. The employer's wage offer would therefore reflect the value of the worker's product less the appropriately amortized charge for the costs of training incurred by the cooperative; the worker would not be able to "capture" the gains in his or her productivity that resulted from the employers' joint investment in the worker.

The collective provision of training reduces the free rider problem that makes the employer financing of training unremunerative. The level of interfirm cooperation required in the training cooperative, however, raises serious antitrust concerns. It may be necessary to give an explicit antitrust exemption to the activity if it is to be attractive to employers, perhaps along the lines of existing legislation designed to foster joint research and development activities among firms. Such a relaxation would not be likely to increase significantly the probability of a successful product market cartel, which is the primary focus of the antitrust laws.

The problem of efficient training mechanism is an important one, especially in this period of intense international competition. Japanese employers, a major focus of competitive concern, are felt to have significant advantages in the provision of training opportunities, because of

cultural biases against job mobility, and toward greater industrial harmony, Hashimoto (1989) and Mincer and Higuchi (1988). Whether these "cultural" factors are a cause or a consequence of the rapid, sustained growth of the Japanese economy is not clear. Nonetheless the concern is a significant one, given the importance of job training. Deeper consideration of the property rights system that supports and retards the training process is warranted.

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